Commentaries

The Global Burden of Injuries

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A B S T R A C T

The traditional view of injuries as "accidents," or random events, has resulted in the historical neglect of this area of public health. However, the most recent estimates show that injuries are among the leading causes of death and disability in the world. They affect all populations, regardless of age, sex, income, or geographic region. In 1998, about 5.8 million people (97.9 per 100 000 population) died of injuries worldwide, and injuries caused 16% of the global burden of disease.

Road traffic injuries are the 10th leading cause of death and the 9th leading cause of the burden of disease; self-inflicted injuries, falls, and interpersonal violence follow closely. Injuries affect mostly young people, often causing long-term disability.

Decreasing the burden of injuries is among the main challenges for public health in the next century—injuries are preventable, and many effective strategies are available. Public health officials must gain a better understanding of the magnitude and characteristics of the problem, contribute to the development and evaluation of injury prevention programs, and develop the best possible prehospital and hospital care and rehabilitation for injured persons. (*Am J Public Health*. 2000;90: 523–526)

Around the world, almost 16 000 people die from injuries every day. For every person who dies of injuries, several thousand injured persons survive, but many of them are left with permanent disabling sequelae. An injury is a bodily lesion at the organic level, resulting from acute exposure to energy (mechanical, thermal, electrical, chemical, or radiant) in amounts that exceed the threshold of physiologic tolerance. In some cases (e.g., in drowning, strangulation, or freezing), the injury results from an insufficiency of a vital element.[1] The external causes of injuries are often categorized as unintentional or intentional. Most traffic injuries, fire-related injuries, falls, drownings, and poisonings are classified as unintentional injuries; injuries due to assaults, self-inflicted violence, and war are classified as intentional injuries.

The traditional view of injuries as "accidents," or random events, has resulted in the historical neglect of this area of public health. During the past few decades, public health officials have recognized that injuries are preventable, and they have established methods of scientific study for the prevention of injuries.[2] The public health approach to injury prevention involves the 4 key steps of an epidemiologic approach to any health problem.[3] The first step is to determine the magnitude, scope, and characteristics of the problem. The second step is to identify the factors that increase the risk of injury or disability and to determine which factors are potentially modifiable. The third step is to assess what measures can be taken to prevent the problem, by using the information acquired in step 2 to design, pilot-test, and evaluate interventions. The final step is to implement the most promising interventions on a broad scale.

This commentary contributes to the first step, the description of the magnitude of the problem. Here we provide the most recent estimates of the magnitude of injuries in the world and a comparison of injuries with other health problems.

The information provided includes both fatal and nonfatal outcomes. Although mortality is a cardinal indicator of the magnitude of injuries as a worldwide health problem, it is important to emphasize that for each death from injury there are many more injuries that result in hospitalization, treatment in emergency departments, treatment by general practitioners or other health personnel, or no treatment at all. In many cases these injuries cause permanent disability. Therefore, to characterize the burden of injury accurately, we must also measure nonfatal outcomes. Disability-adjusted life years (DALYs) take account of this issue by combining the number of years of life lost from premature death with the loss of health from disability among persons with nonfatal injuries.[4] One DALY is 1 lost year of healthy life.

The WHO Database on Diseases and Injuries

The data and tables presented here were selected from a World Health Organization document about the 15 leading causes of death worldwide and the global burden of dis-

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TABLE 1—Leading Causes of Death for Both Sexes in High-Income Countries, 1998: Number of Deaths (Mortality Rate per 100 000)

Rank	Age Group					
	0–4 y	5–14 y	15–44 y	45–59 y	≥ 60 y	All
1	Perinatal conditions 53 198 (104.3)	**Road traffic injuries 5313 (4.9)**	**Road traffic injuries 76 249 (20.7)**	Ischemic heart disease 140 620 (88.0)	Ischemic heart disease 1 719 015 (1042.5)	Ischemic heart disease 1 883 763 (221.3)
2	Congenital abnormalities 25 459 (49.9)	Congenital abnormalities 1491 (1.4)	**Self-inflicted injuries 54 517 (14.8)**	Trachea/bronchus/ lung cancers 67 308 (42.1)	Cerebrovascular disease 835 735 (506.8)	Cerebrovascular disease 893 182 (104.9)
3	Acute lower respiratory infections 5744 (11.3)	Leukemia 1470 (1.4)	**Interpersonal violence 26 196 (7.1)**	Cerebrovascular disease 43 867 (27.4)	Trachea/bronchus/ lung cancers 346 568 (210.2)	Trachea/bronchus/ lung cancers 422 347 (49.6)
4	Measles 5342 (10.5)	Drowning 1159 (1.1)	Ischemic heart disease 24 128 (6.6)	Breast cancers 40 126 (25.1)	Acute lower respiratory infections 286 658 (173.8)	Acute lower respiratory infections 306 187 (36)
5	Diarrheal diseases 4192 (8.2)	**Interpersonal violence 926 (0.9)**	HIV/AIDS 23 462 (6.4)	Cirrhosis of the liver 38 948 (24.4)	Chronic obstructive pulmonary disease 264 968 (160.7)	Chronic obstructive pulmonary disease 280 168 (32.9)
6	Pertussis 3475 (6.8)	Acute lower respiratory infections 821 (0.8)	Cirrhosis of the liver 13 285 (3.6)	**Self-inflicted injuries 31 851 (19.9)**	Colon/rectum cancers 207 234 (125.7)	Colon/rectum cancers 242 996 (28.5)
7	**Road traffic injuries 2328 (4.6)**	Nutritional/endocrine disorders 775 (0.7)	Cerebrovascular disease 12 680 (3.4)	Colon/rectum cancers 30 481 (19.1)	Diabetes mellitus 143 018 (86.7)	Diabetes mellitus 161 069 (18.9)
8	Nutritional/endocrine disorders 1853 (3.6)	**Self-inflicted injuries 702 (0.7)**	Breast cancers 12 137 (3.3)	**Road traffic injuries 22 105 (13.8)**	Stomach cancers 118 001 (71.6)	Breast cancers 160 139 (18.8)
9	Drowning 1512 (3.0)	**Fires 666 (0.6)**	Trachea/bronchus/ lung cancers 8433 (2.3)	Stomach cancers 20 447 (12.8)	Prostate cancers 111 173 (67.4)	Stomach cancers 143 310 (16.8)
10	**Interpersonal violence 1311 (2.6)**	Cerebrovascular disease 407 (0.4)	Poisoning 7700 (2.1)	Pancreas cancers 13 814 (8.6)	Breast cancers 107 874 (65.4)	**Road traffic injuries 141 656 (16.6)**
11	Meningitis 1144 (2.2)	Inflammatory cardiac disease 396 (0.4)	Leukemia 6753 (1.8)	Chronic obstructive pulmonary disease 13 759 (8.6)	Dementias 97 966 (59.4)	**Self-inflicted injuries 129 935 (15.3)**
12	Fires 1048 (2.1)	Lymphoma 337 (0.3)	Lymphoma 6286 (1.7)	Diabetes mellitus 13 716 (8.6)	Pancreas cancers 83 422 (50.6)	Cirrhosis of the liver 121 816 (14.3)
13	Dementias 959 (1.9)	**War injuries 301 (0.3)**	Inflammatory cardiac disease 5963 (1.6)	Lymphoma 13 412 (8.4)	Nephritis/nephrosis 81 798 (49.6)	Prostate cancers 114 807 (13.5)
14	Inflammatory cardiac disease 851 (1.7)	Dementias 297 (0.3)	Colon/rectum cancers 5267 (1.4)	Mouth and oropharynx cancers 12 840 (8.0)	Lymphoma 70 824 (43.0)	Dementias 104 719 (12.3)
15	Tetanus 741 (1.5)	**Falls 272 (0.3)**	Falls 5218 (1.4)	Esophagus cancers 10 735 (6.7)	Cirrhosis of the liver 69 489 (42.1)	Pancreas cancers 99 126 (11.6)

Source. World Health Organization.[5]
Note. Injuries are shown in boldface.

ease[5]; the document is based on the World Health Organization's World Health Report 1999 database.[6] The methods used to compile this database, which contains projected data for 1998, are explained in the statistical annex of the report.

The World Health Report first divides diseases and injuries into 3 broad groups: (1) communicable diseases, maternal and perinatal conditions, and nutritional deficiencies; (2) noncommunicable conditions and diseases; and (3) injuries. Next, each of these groups is divided into categories. For example, injuries are divided into the categories *unintentional* and *intentional*. Following this level of disaggregation, diseases and injuries are further divided into subcategories. For example, unintentional injuries are subdivided into road traffic injuries, poisoning, falls, fires, and drowning, and intentional injuries are subdivided into self-inflicted injuries, interpersonal violence (homicide and violence), and war injuries. The same procedure is followed for the other 2 broad groups of conditions and diseases.

In the World Health Report, the 15 leading causes of death and burden of disease are arrayed by country income level, by age, and by sex. Countries are classified as either high-income or low- or middle-income on the basis of the 1998 world development indicators of the World Bank.[7]

The Burden of Injuries

It is estimated that 5.8 million people worldwide died from injuries in 1998, which corresponds to a rate of 97.9 per 100 000 population. Of these 5.8 million people, 3.8 million were male and 2.0 million were female. Injuries are leading causes of death in all age groups and for both sexes. Road traffic and self-inflicted injuries are the leading causes of

TABLE 2—Leading Causes of Death for Both Sexes in Low- and Middle-Income Countries, 1998: Number of Deaths (Mortality Rate per 100 000)

Rank	Age Group					
	0–4 y	5–14 y	15–44 y	45–59 y	≥60 y	All
1	Perinatal conditions 2 101 802 (380.3)	Acute lower respiratory infections 212 608 (19.7)	HIV/AIDS 1 606 263 (67.0)	Ischemic heart disease 746 527 (124.9)	Ischemic heart disease 4 520 547 (1091.4)	Ischemic heart disease 5 491 646 (109.0)
2	Acute lower respiratory infections 1 844 668 (333.8)	Malaria 209 109 (19.4)	**Road traffic injuries 524 063 (21.9)**	Cerebrovascular disease 556 987 (93.2)	Cerebrovascular disease 3 411 345 (823.6)	Cerebrovascular disease 4 212 944 (83.6)
3	Diarrheal diseases 1 809 966 (327.5)	**Road traffic injuries 156 643 (14.5)**	**Interpersonal violence 483 647 (20.2)**	Tuberculosis 405 265 (84.4)	Chronic obstructive pulmonary disease 1 709 684 (412.8)	Acute lower respiratory infections 3 145 990 (62.4)
4	Measles 882 329 (159.7)	Drowning 156 414 (14.5)	**Self-inflicted injuries 454 103 (19.0)**	Trachea/bronchus/ lung cancers 238 674 (39.9)	Acute lower respiratory infections 898 041 (216.8)	HIV/AIDS 2 253 201 (44.7)
5	Malaria 793 368 (143.6)	Diarrheal diseases 133 682 (12.4)	Tuberculosis 426 104 (17.8)	Cirrhosis of the liver 225 169 (37.7)	Tuberculosis 556 458 (134.3)	Diarrheal diseases 2 211 933 (43.9)
6	Congenital abnormalities 379 390 (68.7)	War injuries 56 984 (5.3)	**War injuries 370 497 (15.5)**	HIV/AIDS 207 788 (34.8)	Trachea/bronchus/ lung cancers 543 305 (131.2)	Perinatal conditions 2 101 802 (41.7)
7	HIV/AIDS 349 712 (63.3)	Nephritis/nephrosis 44 510 (4.1)	Ischemic heart disease 220 428 (9.2)	Liver cancers 195 144 (32.7)	Stomach cancers 443 526 (107.1)	Chronic obstructive pulmonary disease 1 969 084 (39.1)
8	Pertussis 342 296 (61.9)	Congenital abnormalities 41 565 (3.9)	Cerebrovascular disease 183 303 (7.7)	Chronic obstructive pulmonary disease 189 433 (31.7)	Cirrhosis of the liver 286 127 (69.1)	Tuberculosis 1 480 272 (29.4)
9	Tetanus 301 927 (54.6)	Inflammatory cardiac disease 40 407 (3.7)	Drowning 137 297 (5.7)	Stomach cancers 184 764 (30.9)	Diabetes mellitus 283 947 (68.6)	Malaria 1 110 293 (22.0)
10	Protein (energy) malnutrition 214 112 (38.7)	HIV/AIDS 38 876 (3.6)	Cirrhosis of the liver 129 160 (5.4)	**Road traffic injuries 150 208 (25.1)**	Liver cancers 261 315 (63.1)	**Road traffic injuries 1 029 037 (20.4)**
11	Drowning 123 790 (22.4)	Fires 38 302 (3.6)	Fires 119 867 (5.0)	**Self-inflicted injuries 146 626 (24.5)**	Esophagus cancers 258 923 (62.5)	Measles 882 329 (17.5)
12	STDs excluding HIV 118 031 (21.4)	Tuberculosis 38 076 (3.5)	Maternal hemorrhage 116 426 (4.9)	Esophagus cancers 106 617 (17.8)	Nephritis/nephrosis 226 034 (54.6)	Trachea/bronchus/ lung cancers 822 060 (16.3)
13	**War injuries 102 859 (18.6)**	Cerebrovascular disease 37 942 (3.5)	Acute lower respiratory infections 110 946 (4.6)	Breast cancers 92 112 (15.4)	Colon/rectum cancers 217 229 (52.4)	**Self-inflicted injuries 817 762 (16.2)**
14	**Road traffic injuries 80 101 (14.5)**	**Interpersonal violence 34 012 (3.2)**	Rheumatic heart disease 103 401 (4.3)	Diabetes mellitus 91 139 (15.3)	Inflammatory cardiac disease 211 844 (51.1)	**Interpersonal violence 698 187 (13.9)**
15	Meningitis 59 054 (10.7)	Leukemia 33 033 (3.1)	Liver cancers 101 928	Rheumatic heart disease 88 129 (14.7)	Self-inflicted injuries 184 859 (44.6)	Stomach cancers 678 759 (13.5)

Source. World Health Organization.[5]
Note. Injuries are shown in boldface.

injury-related deaths worldwide. Among persons aged 15 through 44 years, injuries account for 6 of the 15 leading causes of death. Among youths, the leading injury-related cause of death is traffic injuries; among persons 45 years and older, it is self-inflicted injuries.

In high-income countries, road traffic injuries, self-inflicted injuries, and interpersonal violence are the 3 leading causes of death among people aged 15 through 44 years (Table 1). Even in low- and middle-income countries, where infectious diseases are predominant, these 3 types of injuries are among the leading causes of death (Table 2). Drowning and war-related injuries are also among the leading causes of death in low- and middle-income countries.

When disability resulting from injuries is also taken into consideration, injuries appear as an even more important health problem. It is estimated that 16% of the world's burden of disease in 1998 can be attributed to injuries. The magnitude of this proportion can be explained by the fact that injuries affect many young people, resulting in a large number of years lost because of premature death or a large number of years lived with disability. Road traffic injuries (17.5%), falls (12.2%), interpersonal violence (10.1%), and self-inflicted injuries (9.7%) are the main injury-related causes of DALYs.

The rankings of leading causes of deaths and leading causes of DALYs have similarities. For example, road traffic injuries were the ninth leading cause of DALYs for all age groups. The main difference between the two is that falls do not appear among the leading causes of death in the world, but they do rank among the leading causes of burden of disease or injury. Falls are the 14th leading cause of DALYs for all age groups combined; for children aged 5 through 14 years, falls are the leading cause of DALYs. Projections for 2020 show that external causes of injury are

expected to rise in the rankings of leading causes of DALYs.[4]

The Role of Public Health

Injuries have been shown to account for a significant health burden on all populations, regardless of age, sex, income, or geographical region. Decreasing the burden of injury is among the main challenges for public health in the next century. Among the important lessons learned during the past decades is certainly that injuries are preventable. Many prevention strategies have already been shown to be effective. Using seat belts in cars, installing fences around swimming pools, storing firearms and ammunition in separate and locked places, and developing flame-resistant clothing and packaging that helps prevent poisoning are among the measures that have contributed to decreasing the burden of injuries.[8–10] Another lesson is that the approach to injury prevention needs to be multidisciplinary and intersectorial. In many cases it is only through effective collaboration between physicians, sociologists, psychologists, lawyers, politicians, engineers, designers, human rights experts, journalists, and other professionals from the public and private sectors that the right injury prevention strategy can be developed and promoted.

The tasks that public health officials in all countries face are diverse. First, we need to improve our understanding of the problem. Data collection on the magnitude of the problem is still in its infancy. In many low- and middle-income countries, no data on the burden of injuries are available. In most high-income countries, data on mortality have been assembled, but very few population-based data on nonfatal outcomes are available.

We need to increase efforts to better document the nonfatal outcomes of injuries. As we have shown, the magnitude and distribution of nonfatal outcomes are different from those of fatal outcomes. More complete information is needed on which to base priorities for prevention. Data on disability and on need for rehabilitation and long-term care are required.

Information on the economic and social costs of injuries must also be collected. Standardized tools for surveillance, surveys, and classification should be developed to allow for better cross-national comparisons. The Centers for Disease Control and Prevention's recommended framework for presenting injury mortality data and the International Classification for External Causes of Injuries, currently being developed by an international working group under the auspices of the World Health Organization, contribute to this effort.[8]

Public health also has an important role to play in continuing the research on risk and protective factors for injuries.

Another crucial area is injury prevention. Providing secondary and tertiary prevention through appropriate prehospital and hospital care and rehabilitation are classical areas of intervention for the health sector. Less classical is primary prevention. Public health has a significant role in designing and promoting primary prevention strategies. Public health officials have already proposed and promoted many measures, such as car seats for children and regulations for water heaters to prevent scalds, that have contributed to a decrease in injuries.[9–11] Additional such measures are needed.

Finally, public health officials can contribute to the evaluation of prevention measures that they or others have proposed. The rigorous evaluation is still a too often forgotten component of injury prevention programs.

As Table 2 shows, even in low- and middle-income countries, where infectious diseases have traditionally been seen as the main public health problem, injuries are among the leading causes of death and disability. Although some injury prevention strategies developed in high-income countries will be appropriate for low- and middle-income countries, others will not.[10–12] It is important to study the appropriateness of transferring measures from one setting to another. It is equally important to develop and evaluate additional strategies adapted to the cultural, social, and economic realities of low- and middle-income countries.

Injuries are preventable, nonrandom events. The data presented here are the most recent estimates of the magnitude of injuries worldwide, both in absolute terms and in comparison with other leading public health problems. Such information is the basis for informed priority setting and decision making. The data clearly show the importance of injuries as a public health problem. The time has come to develop additional and more effective injury prevention strategies that will decrease the impact of injuries on the health of the world's population. □

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